I. C. 6722

June, 1933

DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
SCOTT TURNER, DIRECTOR

INFORMATION CIRCULAR

TIMBER WITHDRAWING AND DEVICES USED FOR THIS PURPOSE IN SOME COAL MINES

RECEIVED
JUL 21 1933
O. S. U. LIBRARY

BY

J. W. PAUL AND J. G. CALVERLEY

I. C. 6722,
June, 1933.

INFORMATION CIRCULAR

DEPARTMENT OF COMMERCE - BUREAU OF MINES

TIMBER WITHDRAWING AND DEVICES USED FOR THIS PURPOSE IN SOME COAL MINES[1]

By J. W. Paul[2] and J. G. Calverley[3]

MEANING AND PURPOSE OF TIMBER WITHDRAWAL

Withdrawing timber in coal mines is done for the purpose of inducing the roof to cave in the mined-out areas and thereby relieve stresses in the immediate roof material over the working places adjacent to the breakline of the roof, thus preventing the crushing of the ends of pillars and adding to the safety of those engaged in pillar extraction. A secondary purpose is the recovery of timber for further use either as props, crossbars, lagging, sprags or cap pieces. At some mines timber is withdrawn as a precaution against fire which may be of spontaneous origin, because wood always aids a fire of any origin.

With some of the power-driven types of machines now in use a greater proportion of mine timber may be recovered, and in mines where pillars are left too narrow for their removal some of the timber in rooms might be salvaged for further use.

In all timber withdrawal operations there is the danger of the roof's falling when the timber is withdrawn, thus introducing a hazard to the persons employed in the work unless they exercise all precautions to give themselves protection.

Improper methods of timber withdrawal have resulted in injuries and fatalities to those engaged in such work. This paper brings to attention a number of these methods and gives information as to better devices and practices which are in use at some mines and may be used by others with safety to those engaged in this seemingly hazardous work.

The information given in this paper has been abstracted and compiled from data in Bureau of Mines reports which have been made on the study of roof in mines operating in the Pittsburgh coal bed in western Pennsylvania, Ohio, and West Virginia. Permission was given by the respective operators for the publication of certain features of the confidential reports relating to a study of falls of roof and coal, and this circular is confined to one phase of the study not specifically treated in other publications.[4]

For the past few years much attention has been devoted to the withdrawal and the recovery of mine timber for the purpose of mine safety and economy.

It has been recognized by many managers of bituminous coal mines that the leaving of timbers in the goaf or gob is not only extremely wasteful but is also the cause of roof stresses in the mined-out area which affect the roof and coal at the active working face. The practice of leaving the supporting timbers in the goaf or mined-out area is largely responsible for the irregular subsidence of the roof found in some mines which results in irregular fractures in the roof strata and gives rise to weak roof conditions in the working place, thus increasing the roof hazard and necessitating extra timbering.

---

[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U.S. Bureau of Mines Information Circular 6722."

[2] Senior mining engineer, U.S. Bureau of Mines, Pittsburgh Experiment Station, Pittsburgh, Pa.

[3] Associate mining engineer, U.S. Bureau of Mines, Pittsburgh Experiment Station, Pittsburgh, Pa.

[4] A study of falls of roof and coal in mines of Harrison County, West Va., Report of Investigations 3110 (1931); A study of falls of roof and coal in mines in the No. 8 Field of Eastern Ohio, Report of Investigations 3070 (1931); Falls of roof and coal in mines operating in the Pittsburgh coal bed in Marion and Monongalia Counties, West Va., Technical Paper 522 (1932); Falls of roof and coal in mines operating in the Pittsburgh coal bed, Panhandle district, West Virginia, Technical Paper 534 (1932); Roof support in coal mines in the Irwin, Greensburg, and Latrobe Basins, Westmoreland County, Pa., Report of Investigations 3113 (1931).

Inasmuch as the operation of timber removal is of some importance with respect to proper roof control, it is often attended with a great amount of risk to the workmen withdrawing the timbers; consequently, this has led to the introduction of a number of methods and devices to eliminate, as far as possible, the hazards in connection with timber withdrawal. (Fig. 1.)

Following is a brief summary of the timber-withdrawal practice followed at a number of bituminous mines studied:

Timber-drawing methods in certain mines in the Pittsburgh coal bed

Means of withdrawing timbers	Eastern Ohio	Western Pennsylvania	West Virginia Northern	West Virginia Panhandle
Blasting	0	X	X	0
Cutting with ax	X	X	-	0
Chain and bar	0	X	X	0
Post-pulling jack	0	X	-	0
Power-driven post puller	0	X	X[1]	0
Locomotive and cable	0	X	-	0

[1] Recently installed in some mines of the district.

From this tabulation it is shown that six of the methods are practiced in western Pennsylvania, three in northern West Virginia, and one in eastern Ohio. In the Panhandle of West Virginia and in eastern Ohio pillars are not recovered; consequently, the need for timber withdrawal is not a part of the routine of mining.

This investigation covers 41 representative bituminous coal mines, 3 of which are in eastern Ohio, 26 in West Virginia, and 12 in western Pennsylvania. Table 1 gives comparative data relative to the mines and districts considered.

Table 1.- Extent of timber withdrawing and persons killed and injured in selected mines

	Eastern Ohio	West Virginia, Marion and Monongalia Counties	West Virginia Panhandle	Western Pennsylvania
Extent timber is withdrawn to create falls	Slight	Slight	Slight	Extensively
Number of timber-withdrawal fatalities	0	3	0	7
Nonfatal injuries	0	0	0	29
Posts used per 1,000 tons	202	75	221	227
Timber recovered, percent	-	-	-	10-60, posts 65-90, blocks

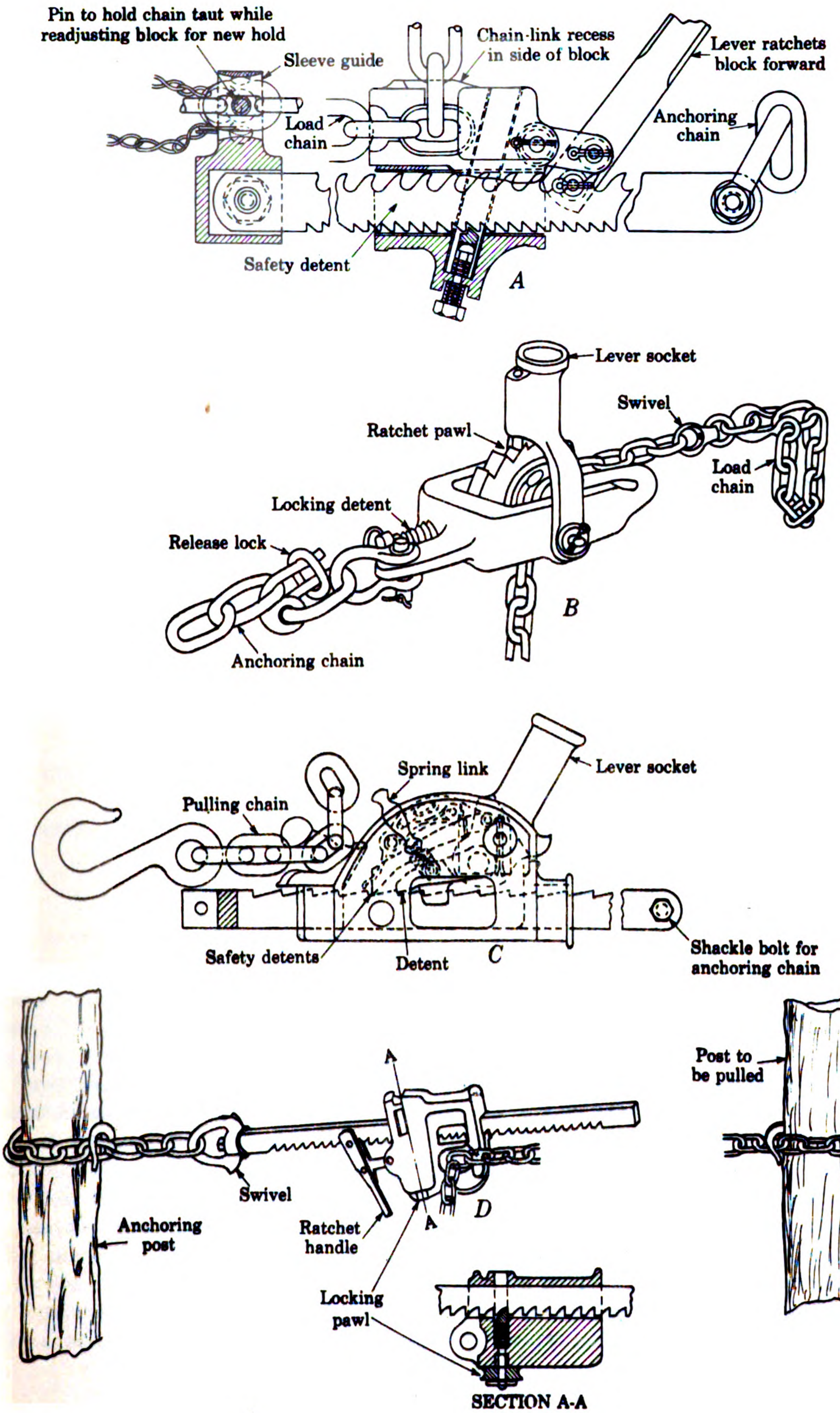

Figure 1.—Types of hand-operated post pullers.

Comparative Data Relative to Timber Withdrawal

Table 2 shows that 10 timber-withdrawal fatal accidents occurred in two of the four districts considered. In each case the fatalities, from falls of roof, were directly caused by the victim's attempt to withdraw supporting timber in the wrong manner: By bumping the supporting posts loose with another post or weakening the supporting posts with an ax. As shown in Table 2, 29 persons were injured nonfatally while in the act of withdrawing or recovering withdrawn timber by wrong methods; 2 by cutting the post with an ax; 11 by using a post for bumping out the timber; 7 when under loose roof to retrieve timber; and 9 as the result of improper use of post pillars.

Table 2.- Classification of timber-withdrawal accidents, fatal and nonfatal, by causes

District	Weakening post by means of an ax		Bumping post loose with a post		Recovering withdrawn timber		Mechanical post puller		Number of accidents		Is timber withdrawal generally practiced?
	Fatal	Non-fatal	Fatal	Non-fatal	Fatal	Non-fatal	Fatal	Non-fatal	Fatal	Non-fatal	
Eastern Ohio	-	-	-	-	-	-	-	-	-	-	No
West Virginia:											
Harrison County	-	-	-	-	-	-	-	-	-	-	No
Panhandle district	-	-	-	-	-	-	-	-	-	-	No
Marion County	2	0	1	-	-	-	-	-	3	-	To some extent
Western Pennsylvania	2	2	5	11	-	7	-	9	7	29	Extensively
Total	4	2	6	11	-	7	-	9	10	29	-

At the time of this study, timber withdrawal was extensively practiced in western Pennsylvania. The other districts under consideration practiced timber withdrawal to a slight extent. However, the mines in Pennsylvania, Ohio, and the Panhandle district of West Virginia used about the same number of posts per 1,000 tons of coal produced. The mines in Marion County, West Virginia, averaged 75 posts per 1,000 tons.

Table 3 gives the relative rates for all falls of roof accidents at the mines under consideration, based upon thousand 300-day workers, severity, and frequency. The frequency rate is a measure of the occurrence based upon the number injured per million hours of exposure; however, the frequency rate of accidents resulting from withdrawing timber does not bear a similar ratio. In Pennsylvania the frequency rate for accidents in timber withdrawal is 1.27 for the 12 mines listed and for the 6 mines in Marion County, West Virginia, the rate is 0.26. However, no nonfatalities were reported as having occurred in Marion County in timber withdrawal work, which is less extensively practiced there than in Pennsylvania.

Table 3.- Number injured per thousand 300-day workers and severity and frequency rates of falls of roof accidents in the mines studied

Mining district	Number of mines studied	Number injured per thousand 300-day workers	Severity rate	Frequency rate
Eastern Ohio	6	113.08	12.10	43.4
Western Pennsylvania[1]	12	52.95	7.32	22.06
West Virginia:				
Harrison County	5	22.16	4.15	9.85
Monongalia County[2]	7	21.49	5.09	9.69
Marion and Monongalia Counties	9	37.62	6.16	16.55
Panhandle district	6	47.25	9.77	21.05

[1] Timber withdrawal is extensively practiced.

[2] Operated in the Sewickley coal bed.

EASTERN OHIO

Timber Withdrawal

Of six representative mines included in the investigation of timber withdrawal in the eastern Ohio district, in one mine only - a mechanical loader equipped mine - was timber withdrawing practiced; this included not more than the posts in the two rows nearest the roadway.

For a period of 8 months for which a record was obtained, about 297,346 tons of coal were produced and about 64,244 mine props were used. Of this number about 32,122 props, or 50 percent, were recovered by the timber crews with the aid of an ax or a post used as a ram; either of these methods is hazardous and should be abandoned in favor of a mechanical post puller.

The mines included in this group are each developed on the room-and-pillar system. The barrier and room pillars are for the most part left standing because no pillars are withdrawn. These pillars represent a very appreciable percentage of the available coal of the mine and to a large extent are a total loss.

PANHANDLE DISTRICT OF WEST VIRGINIA

At none of the six representative mines in the Panhandle District of West Virginia was the withdrawing of timber from the mined-out area practiced, largely because coal pillars are not extracted.

The mines included in this group are all developed on the room-and-pillar system. The rooms are generally driven 24 feet wide and on 32-foot centers, thus leaving for the greater part an 8-foot thick pillar between rooms. Room stumps and entry chain pillars are not extracted. This method of mining leaves a large percentage of the coal standing.

At a number of the mines of this district the management has made an occasional attempt to extract the pillars and to withdraw the timbers, but the attempts were abandoned because the heavy overlying limestone showed no immediate evidence of fracture. At no mine of the group was there evidence that a systematic attempt had been made to extract pillars in conformity with successful methods used in other districts having similar overburden.

It would appear that had the original room pillars been of sufficient thickness to afford support to the main roof while the adjoining area was being mined out, systematic roof falls could be created, resulting in part pillar recovery.

FAIRMONT DISTRICT OF WEST VIRGINIA

Harrison County

This study includes five mines in Harrison County, W. Va., northern district. Timber withdrawal of any consequence was not practiced at any of these mines.

Pillars were for the most part extracted, but the falls along the fracture line were not created by timber withdrawal.

At two of the mines of this group, company rules stated that, where necessary, timbers should be withdrawn by means of an approved mechanical post puller (fig. 1) operated by men familiar with timber recovery work, who do the withdrawing in the presence of the mine foreman or section boss.

Monongalia County

The data in Table 3 for Monongalia County applies to mines operating in the Sewickley coal bed where timber withdrawal is not practiced.

Marion and Monongalia Counties

At nine mines in Marion and Monongalia Counties, operating in the Pittsburgh coal bed, timber withdrawal was practiced to some extent primarily to induce the roof to break along the fracture line where pillars are withdrawn. The six mines, A to F, inclusive, in Marion County either practice timber withdrawal or have regulations for its withdrawal.

Mine A.- At mine A no timber withdrawal or timber recovery of any consequence was practiced at the time of this study; however, at places where it appeared necessary to remove timbers, the following company rule was rigidly enforced:

> Roof timbers shall be pulled only by mechanical means by men experienced in such work and under the direct supervision of the mine foreman or section foreman. Timbers shall be pulled only at regular intervals and line of retreat shall be maintained at all times.

No timber-withdrawal accidents were reported as having occurred.

Mine B.- At mine B the posts in the mined-out area of the pillar places are recovered by the timbermen with a chain-and-bar type of post puller. A large number of the withdrawn posts are used again for roof support and the broken ones are used for lagging. The number of posts recovered was estimated to be 50 percent.

The timber withdrawal and recovery was accomplished with no reported accidents.

Mine C.- At mine C a few posts are withdrawn by means of a mechanical post puller when necessary to create a fall; however, it was observed that posts in a few of the mined-out places had been cut half through with an ax so that they might be easily broken by the weight of the roof.

The practice of cutting a post to weaken it at this mine was responsible for a fatality. A mechanical post puller was available in the place at the time this accident occurred.

Mine D.- At the time of the study at mine D timber withdrawal generally was not practiced; however, a few props were withdrawn from time to time to bring about a roof fall. Created falls were made, generally, in accordance with the following company rule:

> In making falls, the recovery of posts and timbers shall be done only under the supervision of an official or some other competent person and with a post puller or other mechanical device.

Mine E.- Timber withdrawal at mine E was not generally practiced; however, some timbers were withdrawn in the worked-out areas along the fracture line by means of bumping the post to be withdrawn with another post.

During the period of 12 months covered by this study a workman was fatally injured while attempting to bump out a post with another post.

Mine F.- At mine F posts are withdrawn along the break lines as the coal is extracted and for the most part by means of a chain-and-bar device; however, in one instance a fatality occurred because the victim, a timberman, cut with an ax a supporting post to weaken it so it would not retard the caving of the roof.

A company rule states that all timbers be extracted under the direct supervision of a boss or competent timberman and that none be withdrawn by the loaders or inexperienced men.

Figures showing the amount of timber extracted and recovered were not available; however, a high recovery was estimated.

Table 4 gives a summary of timber withdrawal practices of mines A to F, inclusive.

Table 4.- Summary of timber withdrawal practices in mines A to F

Mine	Timber withdrawal	Percent recovery	Method of withdrawal		Withdrawal rules	Means of withdrawal	Timber withdrawal under supervision	Remarks
			Definite	Indefinite				
A	A few	-	Yes	-	Yes	Mechanical	Yes	Posts drawn when necessary.
B	Yes	50	Yes	-	No	Chain and bar	-	Regular timber crews employed.
C[1]	A few	-	-	Yes	No	Bumping post puller and ax	Yes	Rib boss present when making fall; some timbers weakened by ax.
D	A few	-	Yes	-	Yes	Post puller	No	Post drawn when necessary to create a fall.
E[1]	A few	-	-	Yes	Yes	Bumping with post	No	Posts drawn when necessary to create fall.
F[1]	Yes	Large	Yes	-	Yes	Chain and bar cutting with ax	Yes	Timber drawing is practiced to create a fall.

[1] Fatality occurred chargeable to timber withdrawal.

WESTERN PENNSYLVANIA DISTRICT

In the western Pennsylvania district group of mines - A to L - timber withdrawal is for the most part practiced extensively. At each of the mines controlled, fracture lines are maintained. They vary in length 500 feet to more than 3,000 feet; consequently, timber withdrawal is practiced primarily to assist, as far as possible, in maintaining the break

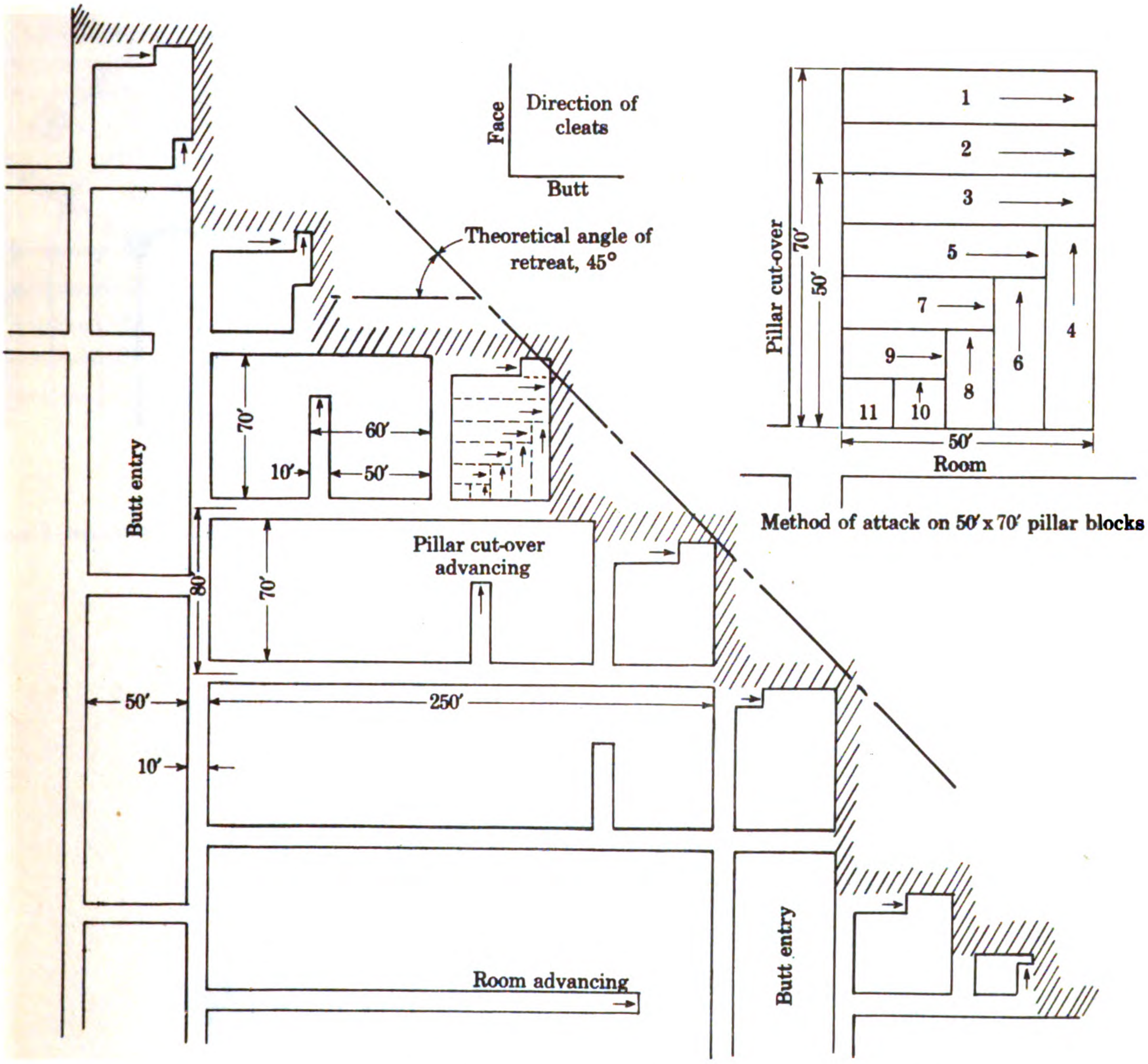

Figure 2.—General method of open-end pillar mining, western Pennsylvania district.

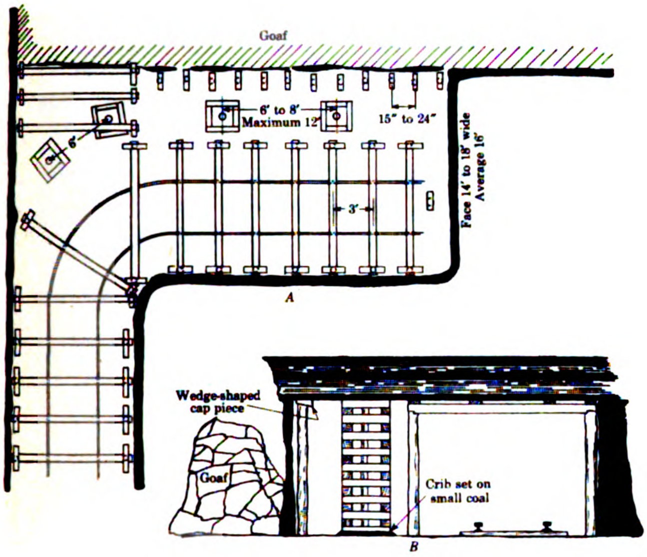

Figure 3.—Details of timbering in pillar work. *A*, Plan of timbering; *B*, section across open end.

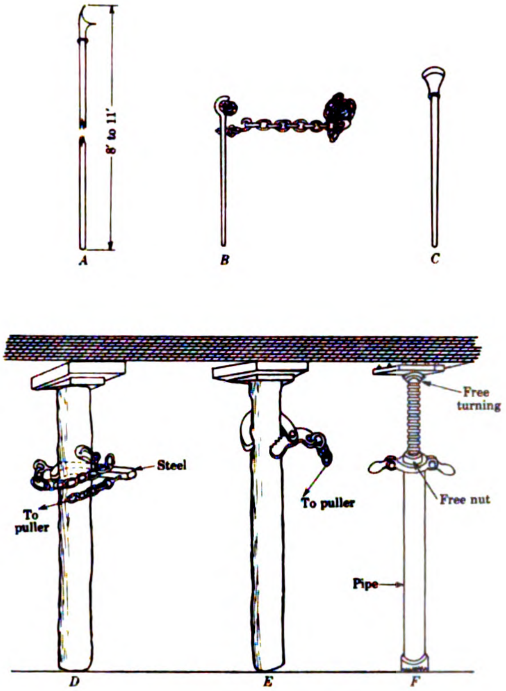

Figure 4.—Timber withdrawal devices. *A*, Timber recovery pike; *B*, bar-and-chain post puller; *C*, ram; *D*, post decapper (tangential); *E*, post decapper; *F*, adjustable post.

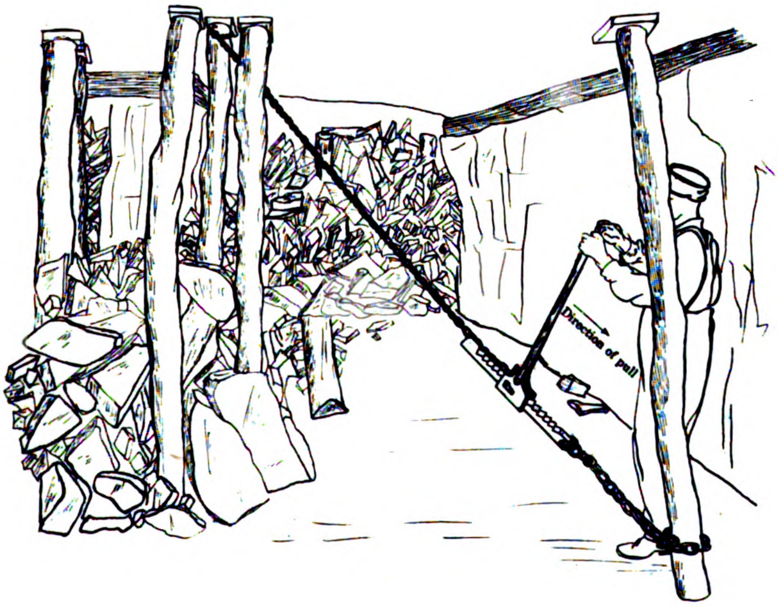

Figure 5.—Method of withdrawing props with post puller.

lines in proper alinement and to prevent the overlying burden from riding over the adjacent active workings with consequent weakening and fracturing of the roof. Figure 2 is a plan of a general method of pillar mining in one district of western Pennsylvania where the break line of the roof is maintained straight by systematic recovery of the pillars by a succession of cuts across the end and side of the pillars, a definite method of timbering, and the systematic withdrawal of the timber following each cutover.

As shown in Table 5, there were 7 fatal and 29 nonfatal injuries from falls of roof while withdrawing timber at the 12 mines, A to L. As previously stated, 5 fatal and 11 nonfatal accidents resulted from bumping a post with another post, 2 fatal and 2 nonfatal accidents from cutting the post with an ax, 6 nonfatal accidents occurred while retrieving posts from under unsupported roof, and 1 nonfatal injury was received while removing a jack.

Table 5.- Cause of timber withdrawal accidents, fatal and nonfatal, mines A to L

Cause	Accidents		
	Fatal	Non-fatal	Total
Knocking post loose by means of another post	5	10	15
Recovering withdrawn posts	-	3	3
Using a mechanical post puller improperly	-	9	9
Recovering cribbing blocks	-	3	3
Cutting supporting post with an ax	2	2	4
Bumping crossbar legs loose	-	1	1
Removing an adjustable jack	-	1	1
Total	7	29	36

Following is a brief discussion relative to timber withdrawal of each mine, A to L, of the methods and practices:

Mine A

At mine A the open-end method of mining is the practice. Closely set posts in each working place are carried next the goaf, and in addition to the posts substantial cribs are erected at regular intervals (fig. 3). When the miners have driven the place to completion, they immediately withdraw the timbers with a mechanical post puller in the presence of an underground official, either the assistant foreman or a rib boss. Following are some of the important company timber-withdrawal rules which are strictly enforced by the underground officials:

> Rule (a). In the making of falls in pillar workings or drawing of timbers in other places, safety posts shall be set to protect the workmen. Breaker rows shall be set in the roadway at the outer edge of all pillar falls before drawing posts or timbers to make a fall.
>
> Rule (b). The knocking out or cutting of posts with an ax or other hand tools is positively prohibited. Where timbers are to be removed, it shall be done with mechanical post puller or other mechanical equipment only.

Rule (c). Would recommend a long hook for use in recovering posts in making falls. The purpose of this is to withdraw posts already released and in positions too dangerous for workmen to enter to recover them. (See fig. 4 for type of pike pole.)

At the time of erecting the crib blocks, some consideration is given to their removal, and a post is placed in the center of the crib at the time of erection. This post is to afford protection to the workmen while erecting the crib and when the crib blocks are being withdrawn; also, the first or bottom blocks are placed on several inches of small coal to facilitate their removal.

During the period 1928-1931, covered by this study, no fatal accidents caused by timber withdrawal were reported. However, there occurred in the same period 6 nonfatal accidents (with total of 97 days lost time), of which 5 were caused by pulling the lever of the post puller toward the goaf and 1 by a fall of roof while the victim was engaged in attaching the chain to a post to be withdrawn. For the most part, since the occurrence of these accidents, those chargeable to the post puller have been eliminated largely by requiring the operator to pull on the post-puller handle away from the goaf rather than push toward the goaf (fig. 5).

Specific figures relative to the number of posts and blocks recovered when withdrawn were not available; however, it was estimated at 25 percent for props and 85 percent for cribbing blocks.

Mine B

The general plan of mine B is substantially the same as mine A except that the pillars are extracted by the pocket-and-stump method rather than the open-end method as in the case of Mine A. Cribs are not used for roof support; only posts and crossbars are used for this purpose.

When the pockets are driven through the pillar and the stump is removed, the timberman immediately withdraws the supporting timber in dangerous places, using a mechanical post puller in the presence of a fall boss and working under the direct supervision of the assistant mine foreman. Except for the places considered dangerous, the general practice of removing timbers is to loosen the cap piece of the supporting post by means of an ax and then to bump the post loose with another post — a hazardous practice conducive to injury to the workmen.

Men have been specially trained for timber withdrawal by the mine foreman, and none other than experienced men are permitted to withdraw timber.

In some extracted areas the withdrawal of posts is not necessary to obtain a rock fall. For the period covered, 1925 to 1928, inclusive, no accidents were reported, fatal or nonfatal, as the result of timber withdrawal.

Mine C

At mine C the timber is generally withdrawn. This induces falls along the pocket-and-stump mined-out area. The timber is extracted largely by means of a mechanical post puller, but some posts are loosened by being bumped with another post—a practice forbidden by the company.

During the period 1929-1930, there occurred 4 timber withdrawal accidents; of these, 3 were caused by withdrawing timber by means other than the post puller, and 1 was caused by a roof fall while recovering a withdrawn post. The accidents resulted in a total of 53 days lost time to the workmen.

Digitized by Google Original from THE OHIO STATE UNIVERSITY

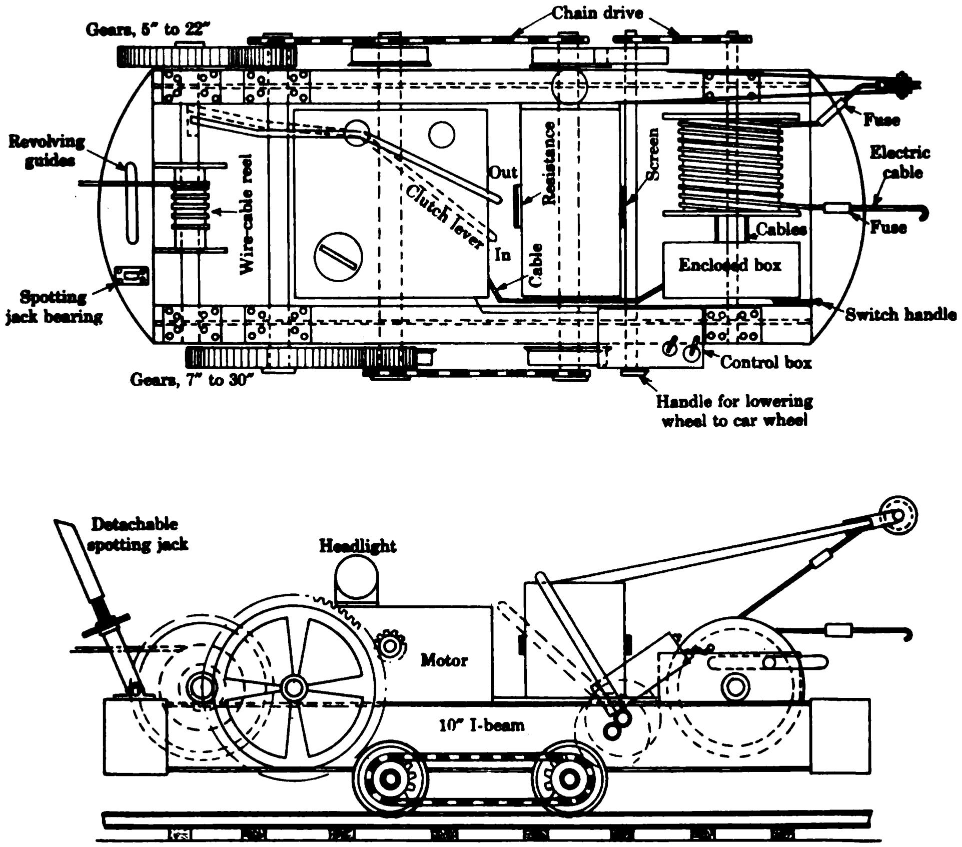

Figure 6.–Electrically driven post puller.

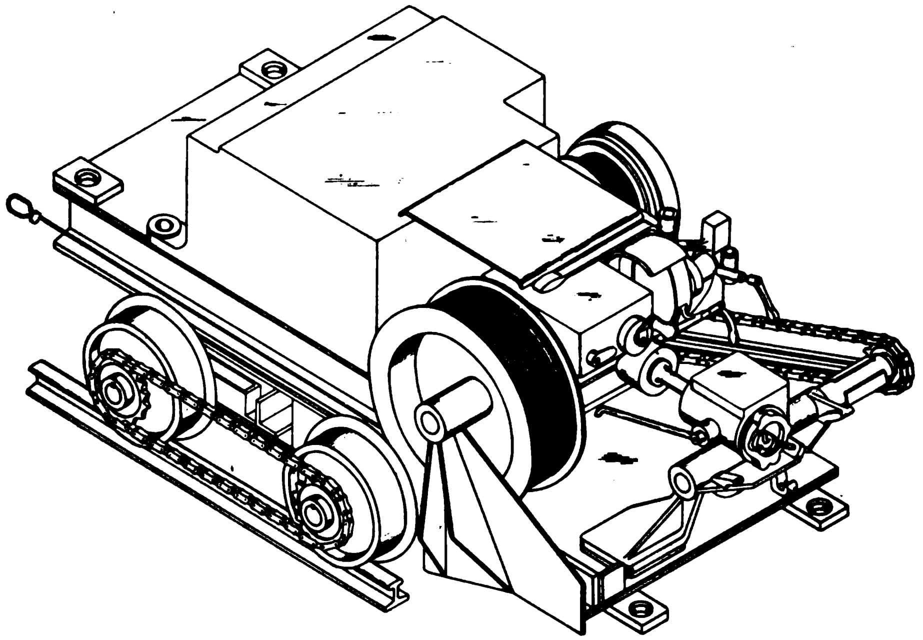

Figure 7.–Mining machine mechanism used as a post puller.

Of the posts used, about 10 percent are regularly recovered and used again.

Mine D

At mine D the withdrawing of timber is extensively practiced along the various pocket-and-stump fracture lines.

At the time of this study the withdrawing was accomplished by specially trained timbermen and generally by the aid of a hand-power mechanical post puller; since this investigation, however, an electrically driven post puller (fig. 6) has to a large extent superseded the bar-and-chain type which was formerly used.

It was learned that the withdrawing of some posts by means other than a mechanical post puller resulted in 5 timber withdrawal accidents, one of which was a fatality caused by the fall which the victim was creating when removing the timber by means of another post used as a ram.

Accurate data relative to the actual number of pieces of timber recovered were not available; however, the percentage was high.

Mine E

At mine E specially trained timbermen use a mechanical post puller to withdraw timbers along the controlled fracture line of the pocket-and-stump mined-out area. The practice of bumping posts loose or hacking them with an ax is strictly prohibited. Over a period of 21 months no injury was reported as the result of withdrawing timber.

Mine F

At mine F timber withdrawing is intensively practiced along all the fracture lines. The withdrawing, generally, is accomplished with an electrically driven, post-pulling machine operated by specially trained timbermen.

At this mine one of the earliest power-driven post pullers was developed from suitable parts of a mining machine (fig. 7); it is novel in that more than one prop can be withdrawn at a time by the use of chains of different length attached to the main cable. This machine has given satisfactory results as to safety and economy.

Prior to the installation of the power-driven machine, the withdrawal was accomplished by a bar-and-chain post puller.

During the period 1928-1930 5 timber-withdrawal accidents occurred, 1 fatal and 4 nonfatal. Four of these were chargeable to the bar-and-chain post puller which was defective at the time of the accidents and the other was due to the victim's withdrawing a post by hand and bringing about a fall of roof.

The percentage of timber withdrawal and recovery at this mine is high since installation of the power-driven post puller. It is recorded that for a 38-month period, 119,324 pieces of material were salvaged without a timber-withdrawal accident. It was also recorded that the operating index of tons of coal produced per prop used increased from approximately 4 to 7.

Mine G

At the time of the study at mine G, generally no attempt was made to withdraw posts from the extracted area along the pocket-and-stump fracture line; since that time, however, an electrically driven post puller has been installed and the practice of post withdrawal has given creditable results as to safety and economy (fig. 7).

During 1929-1930, one timber-withdrawal accident occurred when bumping out a post caused a roof fall, resulting in 18 days' lost time to the victim.

Inasmuch as the general mining conditions and practices are about the same as those at mine F, the ratio of timber withdrawal and recovery will be approximately the same since the installation of the power-driven post puller.

Mine H

At mine H the open-end method of mining is used which is similar to the practice which prevails at mine A of this group; consequently, systematic timber withdrawal is followed in order that a controlled fracture line may be maintained along the goaf of the mined-out area and the active working face.

The timbering consists of posts and substantial block cribs (blocks 5 by 5 by 30 inches). It was observed that no consideration was given at the time of erecting the cribs to providing for their facile and safe withdrawal as were the practices at mine A. No posts were used in the center, adjacent to, or near the crib to afford roof support while the crib was being dismantled at the time of withdrawal, nor were the cribs, generally, built on a few inches of small coal; these practices are not conducive to safe timber withdrawal (fig. 8).

When falls are being created along the fracture line, special timbermen withdraw and recover the timber. The timber generally is withdrawn by a mechanical post puller of the bar-and-chain type. It was observed, however, that in some cases the tight posts were hacked with an ax or bumped loose with another post; either of these practices is hazardous.

During a period of 44 months there were 5 nonfatal timber withdrawal accidents; 2 of these were caused by the victim's bumping the supporting posts loose and the others were caused by falls of the roof material while the victims were engaged in recovering the dislodged timbers. These accidents resulted in 637 lost days to the workmen.

About 25 percent of the posts and about 60 percent of the crib blocks are recovered by the timbermen.

Mine I

At mine I timber withdrawing is not practiced generally; however, some posts are withdrawn by the miners by means other than a mechanical post puller and for purposes other than creating roof falls.

During the 12-months period covered by this study, 2 fatal accidents occurred; one of these was caused by the victim's cutting a tight post loose by means of an ax, and the other by the victim's bumping a post out with another post, the roof falling in each case.

Mine J

At mine J the open-end method of mining the pillars is practiced. Closely set posts in each working place are carried next the goaf, and in addition substantial block cribs are erected at 8 to 10 foot intervals. The bottom blocks of the crib are placed on small coal and the crib is erected around a substantial post (fig. 8, A).

As soon as the place is driven to completion, timber withdrawal is commenced by the miners, who generally use a mechanical post puller and work under the direct supervision of a fall boss or special timberman.

During the period 1928-1930, 2 timber-withdrawal fatalities occurred which were caused by the victim's bumping out the supporting legs of a collar, which permitted the roof to fall upon him.

Of the props and cribbing blocks used, 60 percent and 90 percent respectively are recovered.

Mine K

At mine K the mining and timber-withdrawal practices are substantially the same as those of mine J.

In the period, 1928 through the first 4 months of 1932, inclusive, there were 7 timber-withdrawal accidents; one of these was fatal and was caused by a fall of roof while the victim was making an effort to weaken a supporting post by means of an ax to facilitate its removal.

Two of the nonfatal accidents were caused by falling roof while the victims were bumping a supporting post loose with another post, resulting in a total of 137 days lost time. Two of the accidents were caused by the workmen removing the supporting post and not erecting temporary posts before dismantling cribs and collar sets. One accident occurred while the victim was engaged at placing the post puller chain around a post to be withdrawn; a roof fall injured him. The other accident occurred while the workman was withdrawing an adjustable post jack (fig. 4, F). The accidents resulted in a total of 1,472 days lost time.

Of the posts and crib blocks used, about 60 percent and 85 percent respectively were recovered.

Mine L

At mine L the withdrawal of timber along the fracture lines of the mined-out areas is followed intensively.

Fracture lines as long as 1,500 feet are maintained. Immediately on completion of respective pocket-and-stump pillar places the systematic withdrawing of timbers is commenced. Timber withdrawal is accomplished with a mechanical post puller operated by miners who are directly in charge of a specially trained fall boss and in the presence of an assistant foreman or section boss.

In the 12-month period covered by the study at this mine no timber withdrawal accidents occurred.

Specific data relative to amount of timbers recovered were not available; however, the percentage of recovery was reported to be high.

WITHDRAWAL METHODS AND DEVICES USED

Butting Out With a Prop

Table 2 classifies 39 timber-withdrawal accidents, of which 10 were fatalities; of these fatalities, 6 were charged to falls of roof caused by the victim's bumping the supporting posts loose with another post to create a roof fall.. Eleven persons were nonfatally injured while similarly engaged.

The practice of bumping posts out by means of another post is especially hazardous, inasmuch as the person bumping loose the supporting post is of necessity directly under the area of the immediate roof which is being supported by the timber about to be withdrawn.

Cutting With an Ax

In some mines included in this study it was observed that in order to assist the roof of the mined-out area to fall, the roof-supporting posts were weakened by cutting a portion of the post with an ax. This is a hazardous practice and should be prohibited. Table 2 shows 4 fatal and 2 nonfatal accidents as the result of this practice.

In addition to the immediate danger of the falling of the roof which is supported by the timbers that are being removed, the effective forces of the falling roof are probably transmitted through the roof area for several feet from the part from which the timbers have been removed. Men withdrawing timbers should therefore always protect themselves by setting posts where necessary.

It is of interest here to mention a fatality, caused by falling roof material, that occurred in one of the mines in the group. The fall was attributed to the fact that the material was dislodged by forces which were transmitted through the roof by a created fall 20 yards distant from where the fatality occurred. The victim had purposely retreated some distance from his working place to avoid the danger of being struck by material of the created fall.

Removing Material From the Lower End of the Post by Pick

At some mines when supporting posts are about to be withdrawn it is the practice for the miners engaged at this work to loosen the material from around the foot of the post with a pick rather than to decap the post or loosen it at the top. The first method is preferable to that of picking or cutting loose the supporting post's cap, because the immediate roof is not likely to be subject to as much disturbance with consequent hazards of falling loose material from the immediate roof directly above the supporting post. Removing material from the bottom of a post should be preliminary only to its removal by some mechanical means.

Knocking Out Post With a Sledge or Ax

The practice of hammering supporting posts loose by means of an implement such as an ax or sledge is followed at a number of mines. This is a precarious practice and should be prohibited because it has been the direct cause of a number of falls of roof accidents which have resulted in fatalities.

Blasting Out Post

At some mines, supporting posts about to be withdrawn are blasted out of a mined-out area when falls are being made. The blasting out of the posts is especially hazardous because of the possibility that the blast will affect the permanent timbers and the immediate roof of the adjoining active workings so as to cause roof material to fall. Its use introduces avoidable potential hazards, including fire, which might result in an explosion of accumulated coal-dust or gas.

Mechanical Devices

Cable and Ratchet Device.- Timber withdrawal in the mines included in this study was generally by means of a mechanical post puller, bar, rack, or chain-wheel ratchet with chain (fig. 1, A, B, C, and D).

It is worthy of mention that of the 39 classified timber withdrawal accidents, 10 of which proved fatal, no fatalities were charged to mechanical post puller methods; and, of the 9 accidents charged to the mechanical post puller method, all were of a minor nature and could have been avoided with the proper precaution. Some of the causes leading to these injuries were using apparatus with defective mechanism; not fastening securely the mechanical pulling device to the anchoring post; and the puller operator's standing too near and in front of the puller handle and the anchor post rather than to the rear of the puller handle and to the side of the anchor post (fig. 5). Of the 9 accidents referred to, all were due, largely, to the victims' disregard for the essential precautions.

Locomotive and Cable.- At some mines use is made of a haulage locomotive to withdraw timbers from the mined-out areas. Of the various types used, the hoist-equipped locomotive is the one most adaptable for timber-withdrawal because it may be maintained in a fixed position and the hoist used to advantage to pull out the timbers. In this case the operator is better able to see the withdrawal operation, but when the locomotive and cable only are used, the locomotive is of necessity moving away and consequently the operator is out of view of the withdrawal.

Power-driven Post Puller.- Timber extraction at a few mines where it is extensively practiced is accomplished by means of a self-propelled machine, designed especially for the purpose of timber withdrawal (figs. 6 and 7).

These machines consist, for the most part, of the discarded parts of various types of mining machines, such as truck, motor, and drums; however, in some cases, additional parts are added, such as adaptable gear wheels, clutch, drum, and drum brake.

Essentially these post-pulling machines consist of a series-wound, d.c. motor equipped with the necessary hoist parts mounted on a self-propelled truck with anchoring jacks (hinged fixed), usually four in number, one at each corner of the truck. Figure 6 illustrates some of the essential parts used on a certain mining machine which has been reconditioned for the purpose of withdrawing timbers.

The power-driven post puller has proved highly satisfactory as to safety and economy. At one of the mines included in this study and at which a power-driven machine was being used, several hundred thousand posts have been withdrawn, and the recovery has resulted in a timber-cost reduction of about 2 cents per ton; in accomplishing this recovery, no accident occurred. Timber withdrawal accidents are largely eliminated when the power-driven post puller is used, particularly those accidents due to falling roof material resulting from withdrawal of the supporting posts.

With a power-driven machine's pulling cable to which are attached several post hitching-chains of different lengths, it is possible to withdraw several posts in one operation. The immediate roof from which the timbers are extracted is weakened as each supporting post is withdrawn, thus resulting in the created fall. This feature has the advantage that the persons engaged at withdrawal need not be near the withdrawal area each time a post is about to be removed, as is the case when the posts are drawn one at a time.

CONCLUSIONS

1. Any method of timber withdrawal employed should permit the workmen to be in a safe place while the timber is being withdrawn.

2. Mechanical power-driven devices may justify the withdrawal of timber from mines operating in thin coal which is too expensively removed by hand-power devices.

3. Mechanical, power-driven, timber-withdrawing machines may be assembled largely from discarded parts of coal-cutting machines.

4. It should be noted that where it is the practice to withdraw timber, most of the companies have definite rules forbidding cutting with an ax or knocking out by a ram or hand tool, and that in each case of a fatality this rule was disregarded. This fact brings to attention the necessity of enforcing more rigid discipline among those engaged in withdrawing timber.

5. The advantage of the practice of withdrawing timber is twofold: First, it aids in establishing a uniform break in the lower roof members which induces the main roof to break and subside*; second, it tends to prevent the roof over the working places from breaking, thereby reducing the hazard from falling material, less of which will have to be handled or loaded for disposal.

6. Withdrawing timber systematically along the pillar-extraction line aids in establishing a break line in the roof, uniform subsidence of the roof, avoids the crushing of pillars, and affords a high degree of extraction, which is in the interest of conservation and economy.

7. A corollary to systematic withdrawal of timber is a systematic method of placing timber for support of the immediate roof as the advance work progresses.

TIMBER-WITHDRAWAL RECOMMENDATIONS

1. The withdrawal of timber in mined-out areas should be attempted only in the presence and under the direct supervision of the mine foreman or one of his assistants who is experienced and thoroughly familiar with timber withdrawing.

2. For the protection of persons engaged in the work, the immediate roof near the place where timber is being withdrawn should be temporarily supported by some suitable means, preferably by adjustable posts, jack type (fig. 4, F).

3. Withdrawing timber should be accomplished by mechanical means only.

4. The uncapping of timbers should be accomplished by mechanical means, tangential pulling device (fig. 4, D).

5. The pulling chain or cable should be of sufficient length not to necessitate the placing of the post pullers too near the edge of the proposed break line of the roof.

6. Post-puller operators should be required to manipulate the machines from a position in the rear of the machine and not from the front - which means not between the post puller and the gob (fig. 5).

7. The use of power-driven post pullers which are capable of withdrawing several posts in one operation and dragging them to a place where they may be salvaged, should be required in the interest of increased safety.

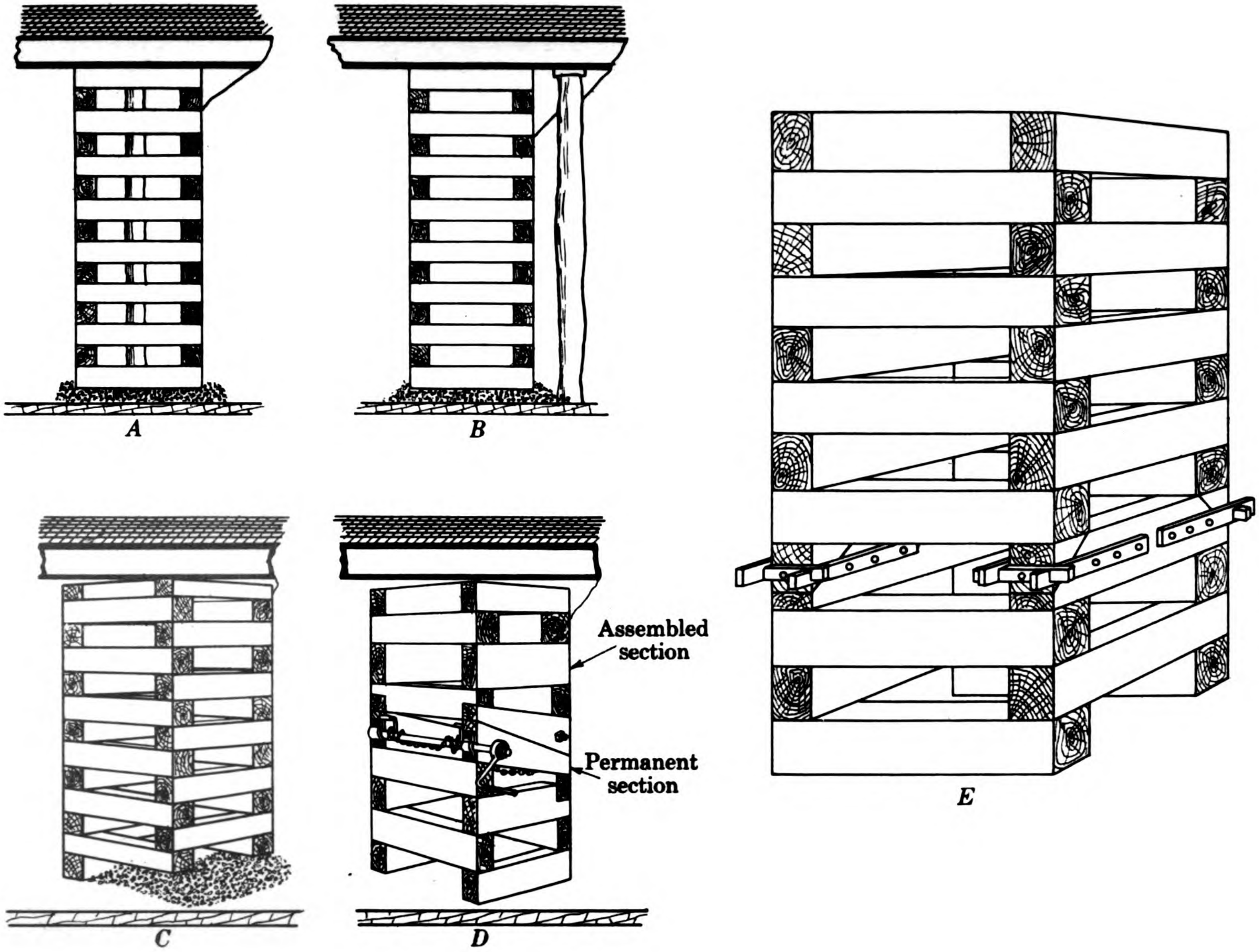

Figure 8.—Types of cribs used in open-end work and in shortwall mining. *A*, Crib with center post; *B*, crib with post adjacent; *C*, crib resting on loose coal; *D*, built-up crib with wedge contact posts for adjustment; *E*, proposed temporary crib.